Particulate Matter and Winter Weather Conditions of Pendleton, OR

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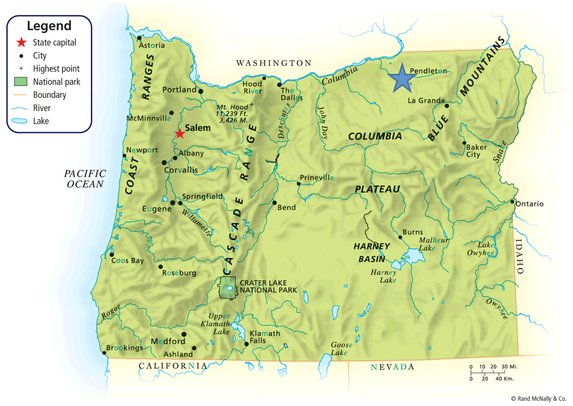
Background



Particulate matter and relative humidity both affect the quality of air, and in turn affect the quality of life. Particulate matter is categorized as fine (2.5 microns or less) or coarse (10.0 microns or less). Particulate matter comes from both natural and man-made sources. Weather conditions impact the concentrations of particulate matter. Most familiar are air inversions, which trap particulate matter and other pollutants close to the surface. Without inversions, pollutants rise or move with the air through advection and convection, reducing their impact on air quality. Wind and precipitation also move, or even remove, particulate matter.

Local air quality evaluations are based primarily on particulate matter readings along with weather conditions. Pendleton, like many communities located in basins, has a recurring problem with stagnant air during the winter months. While other pollutants remain at low levels, particulate matter counts increase dramatically with cold inversions trapping air down in the basin. “Air stagnation alerts” are common from October to March, except during times of wet and windy weather systems passing through, when cold Arctic air masses move south.

Particulate matter data is collected and reported by the Oregon Department of Environmental Quality to the Environmental Protection Agency for use by local government agencies as part of air quality index calculations. Local weather data is available from the National Weather Service. Long term weather data presented here was obtained from retrieved from NOAA.

If weather patterns produce the conditions that result in high levels of particulate matter values, then certain weather conditions should consistently be associated with high or low values. Comparing particulate matter data with weather data of the same time period will help identify any related occurrences.

Satellite observations made over the same area are compared to ground station data on Infusing satellite Data into Environmental Applications, comparing aerosol optical depth to particulate matter.

References

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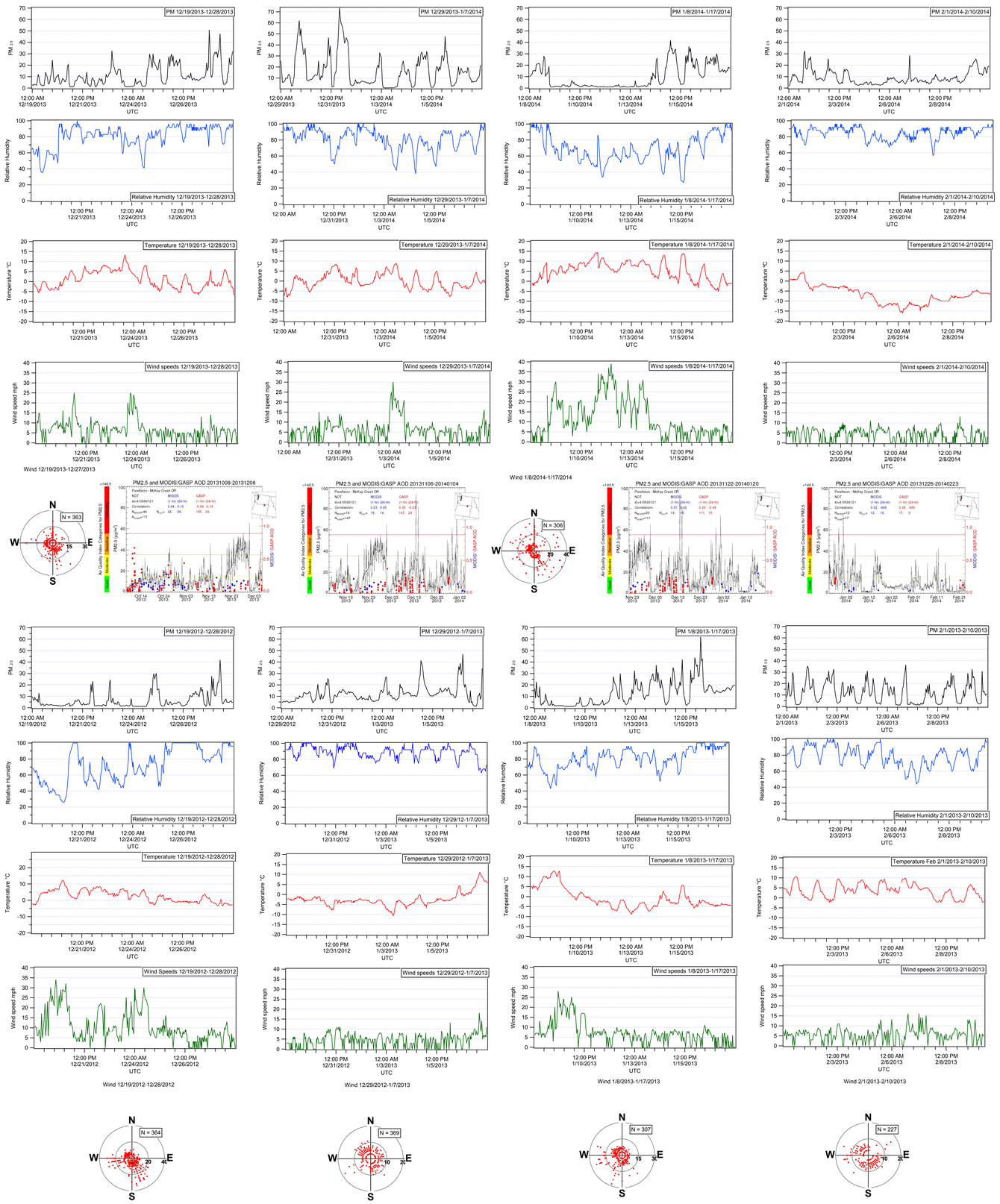
Particulate matter sizes

$PM_{2.5}$ Data and Weather Conditions at Selected Times



SMS Student Work

7th grade students at Sunridge Middle School participate in a unit on the atmosphere. Air Quality is an extension of this unit as Pendleton, OR has a recognized problem with air quality. The City of Pendleton supports the science program’s air quality unit with a culminating poster contest each term. Local officials from the City of Pendleton, Confederated Tribes of the Umatilla and the National Weather Service Office of Pendleton make a presentation and honor the poster winners. Approximately 300 students participate during the school year.

During the unit students learn about the composition and structure of the atmosphere. Air pollution issues are investigated, with a focus on Pendleton’s unique problems including topography, weather, and climate. Lab activities involve concentration, detection of air pollutants, and physical collection of particulate matter. The beginning lessons regarding air quality introduce local resources and access to daily data. Prevention and mitigation of local air quality problems are an integral part of the curriculum. In addition to studies of seasonal particulate counts, students joined me in comparing relative humidity with $PM_{2.5}$ data.

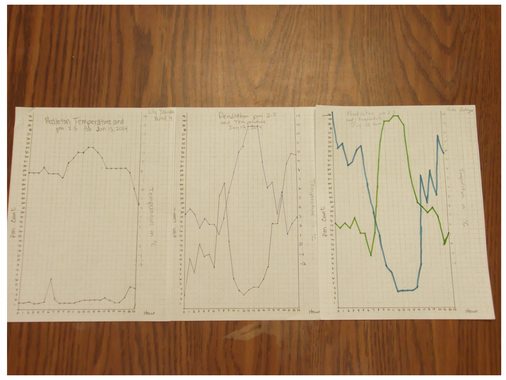


Fig X Student graphs of temperature and particulate matter over 72 hours

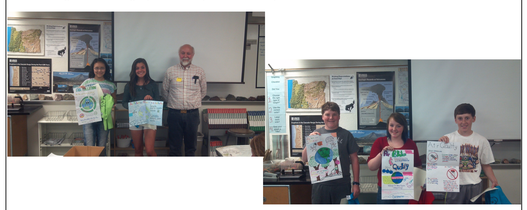


Fig X Poster contest winners 2014

Summary

Relative humidity and temperature show a daily inverse relationship with lower RH values as the temperature rises during the day, as expected. Similarities exist between the graphs of relative humidity and particulate matter, however there is no consistent pattern of crests and troughs. Periods of high wind speeds coincide with periods of low particulate readings, as expected.

Acknowledgements

This work was supported by the Long-term Engagement in Authentic Research with NASA (LEARN) project with funding provided to a NASA SMD EPOESS grant. The NASA Langley LEARN Project facilitated access and analysis of air quality observations including $PM_{2.5}$, and weather observation data. Grade-level appropriate related activities were conducted at Sunridge Middle School.